

Small Satellites – Smart Laws? Small Satellite Projects in the Face of National Space Legislation – Austria

*Anita Rinner**

The present paper addresses issues relating to Nano-, Pico-, and Cube satellites, which may be launched by non-governmental entities and individuals. It examines the influence of domestic space law (hereinafter: The Austrian Outer Space Act) on small satellite projects and identifies legal challenges faced by small satellite projects that operate on a low budget approach. The paper seeks to answer questions as to whether the benefits of small satellite technology, such as the opportunity for potential users, including non-governmental entities and individuals, to actively participate in space activities to address the complex legal issues intriguingly embedded in the space environment. It also considers the fact that with greater access to space, an increasing number of users will naturally pose a challenge to space debris mitigation.

1. Introduction

Recent advances in small satellite technology have facilitated the design of Nano-, Pico-, and Cube satellites. These small spacecraft are generally no bigger than a brick and usually weigh less than 10 kg. Due to their relatively low production costs, shorter production time and the possibility of being launched as secondary payloads, such satellites are becoming increasingly present in outer space. In addition, Nano-, Pico-, and Cube satellites often use commercial off-the-shelf (COTS) components which are more readily available to non-governmental entities or even individuals at affordable costs. As a result, small satellites may be launched for cultural, artistic or purely personal goals rather than exclusively scientific purposes. This also allows small satellites to be used as a tool to democratise space. Democratising space in this way, through the use of small satellites, still faces certain limits, due to the inherent growing problem of space debris. Of particular concern are the numerous small satellites that are launched to critical orbits with no means to actively deorbit.

* University of Graz, Austria, a.rinner@edu.uni-graz.at.

1.1 Subject

1.1.1 Outer Space Democratisation

For decades, only large space faring nations with sufficient financial capacities and technological abilities had access to space. However, given the fast developments in small satellite technology, emerging and developing countries, non-governmental entities, universities and academic institutions as well as individuals have been able to enter space at affordable costs, using adequate technological capacities. Small satellites enable numerous new actors to access space and serve as a tool to democratise space (quantitative aspect).¹ An increase in the number of space actors – in particular of non-space faring nations originating from developing countries – can be seen as in the spirit of Art I Outer Space Treaty² (OST). This provision states that “*The exploration and use of space (...) shall be carried out for the benefit and in the interest of all countries regardless of their economic development*”.

Access to space builds up national technological capacities, which introduce a multiplier effect on the economic and technological capabilities of that country. This positive effect on a country’s socio-economic fabric can be to develop national scientific infrastructures, educational programmes, Earth observation and disaster monitoring etc. (qualitative aspect of outer space democratisation).³

1.1.2 Limits of Outer Space Democratisation

In particular the quantitative aspect of outer space democratisation has factual and legal limitations.⁴ A rising number of space actors highlight the issue of space debris mitigation. Increasing figures of orbiting spacecraft generate higher collision probabilities, raising questions of liability in cases of damage in outer space. Art. IX OST states that “*States Parties to the Treaty (...) shall conduct all their activities in outer space (...) with due regard to the corresponding interests of all other States Parties to the Treaty.*” This article can be interpreted along the lines that individual states should avoid and reduce space debris to allow all states to participate in outer space activities with a minimum of risk.⁵

1 See A. RINNER, A NEW APPROACH TOWARDS OUTER SPACE ‘DEMOCRATISATION’? LEGAL, POLITICAL AND ECONOMIC ISSUES CONCERNING SMALL SATELLITE MISSIONS IN: R. SANDAU, H.P. RÖSER, A. VALENZUELA (EDS.): DIGEST OF THE 9TH INTERNATIONAL SYMPOSIUM OF THE INTERNATIONAL ACADEMY OF ASTRONAUTICS, 195 (BERLIN, APRIL 8-12, 2013).

2 TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES (1966) UNTS 205.

3 See A. RINNER, A NEW APPROACH TOWARDS OUTER SPACE ‘DEMOCRATISATION’, FN I ABOBE, 195.

4 Ibid.

5 See J. WHEELER, SPACE DEBRIS: LEGAL FRAMEWORK, ISSUES ARISING AND NEW ISO GUIDELINES IN: P. HULSROJ, S. PAGKRATIS, B. BARANES (EDS.): YEARBOOK ON SPACE POLICY 2010/2011. THE FORWARD LOOK, EUROPEAN SPACE POLICY INSTITUTE, 256 (SPRINGERWIENNEWYORK, 2013).

1.2 Definition

1.2.1 Small Satellites

There is no universal definition of a small satellite. Small satellites can be roughly classified by their mass. The range anywhere between 10-120 kg is referred to as Micro satellites, while those weighing 1-10 kg are commonly referred to as Nano satellites. Over the last decades, the number of Pico satellites, which refer to < 1 kg, has been on the increase.⁶ The scope of small satellite applications is extensive. They range from telecommunications, Earth observation and technology demonstration, all the way to academic training.⁷ The latter applications, in particular technology and testing, have grown significantly over the last seven years.⁸ This field is dominated by space agencies, universities, and academia.⁹ At the same time, it can be seen that there is increasing utilisation of small satellites for individual space activities. The use of small satellites for artistic purposes has also intensified.¹⁰ Companies offer small satellite kits, including launching opportunities, as a secondary payload at low prices which have become affordable, even to individuals.¹¹

1.2.2 The Austrian Outer Space Act

Currently only a limited number of states have enacted rules concerning space activities (national space legislation).¹² The Austrian Outer Space Act¹³ is one of the most recent pieces of national space legislation. It was passed in 2011 because of the commissioned launch of the first two Austrian small satellites.¹⁴ This act constitutes modern and dynamic legislation which meets actual global challenges such as space debris mitigation and international liability in cases

6 See FOCUS OF THE YEAR: SMALL SPACECRAFT IN: ASD EUROSPACE REPORT, 1ST EDITION, 10 (MAY 2012), FIGURE 41, *available at* <<http://euospace.org/>> [latest accessed 3 September 2013].

7 See SMALL SATELLITE MISSIONS BACKGROUND PAPER NUMBER 9, A/CONF.184./BP/9, PARA 19-43 (1998), *available at* <<http://daccess-dds-ny.un.org/doc/UNDOC/LTD/V98/538/62/PDF/V9853862.pdf?OpenElement>> [latest accessed 3 September 2013].

8 See FOCUS OF THE YEAR: SMALL SPACECRAFT, FN 6 ABOVE, 10, FIGURE 41.

9 Ibid. FIGURE 44.

10 For instance, an Austrian project called mur.sat – a space art project, *available at* <<http://sat.mur.at/>> [latest accessed 3 September 2013].

11 See for example the company Interorbital Systems which offers Small Satellite Kits starting from \$ 8,000 the launch is included. Information *available at* <www.interorbital.com/index.html> [latest accessed 3 September 2013].

12 A list of national space acts and provisions concerning space law matters is *available at* <www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html> [latest accessed 3 September 2013].

13 FEDERAL LAW GAZETTE I NO. 132/2011 OF 27 DECEMBER 2011 *available at* <www.oosa.unvienna.org/pdf/spacelaw/national/austria/austrian-outer-space-actE.pdf> [latest accessed 3 September 2013].

14 See I. MARBOE, THE NEW AUSTRIAN OUTER SPACE ACT IN: ZLW 61. JG. 1/2012, 26.

of damage. It highlights two major issues which render this act special. First, it states that the acceptance of the recognised space debris mitigation guidelines is a pre-condition for obtaining authorisation for space activities. Second, the act stipulates a mandatory insurance obligation at a minimum coverage of € 60,000,000. This amount can be waived or downgraded if the activity serves scientific, research or educational purposes.

2 Space Debris Mitigation

2.1 The Austrian Outer Space Act – The Influence on Small Satellite Missions

One of the authorisation conditions for space activities in Austria is laid down in § 4 (1) item 4 in conjunction with § 5 of the Austrian Outer Space Act. These provisions state that space activities should be carried out with due consideration for the internationally recognised guidelines. The preparatory discussion papers¹⁵ on the Austrian Outer Space Act explicitly refer in this context to the Inter-Agency Space Debris Coordination Committee (IADC) Space debris mitigation guidelines¹⁶ and to the UNCOPUOS Space Debris Mitigation Guidelines.¹⁷ Whereas the UNCOPUOS Guidelines contain no quantitative limitations, the IADC Guidelines stipulate a 25-year in orbit life-time limit for each spacecraft in the low Earth orbit (LEO), after mission completion (item 5.3.2). This means that a space object has to be actively removed or de-orbited within 25 years after its mission completion when in LEO. The IADC guidelines may be fulfilled voluntarily and are legally non-binding. However, implementation of the internationally recognised guidelines as a pre-condition for authorisation under national space legislation – such as is the case under the Austrian Outer Space Act – would, effectively transform a non-binding rule (soft law) into a binding rule (hard law) – a crucial step in order to obtain authorisation at national level.¹⁸

It is still questionable whether a provision with a mere reference to internationally recognised guidelines (“in due consideration of”) is enough determination

15 See the result on the decision of the FEDERAL COUNCIL OF 15 DECEMBER 2011, XXIV GP – REGIERUNGSVORLAGE – MATERIALIEN, *available at* <www.parlament.gv.at> [latest accessed 3 September 2013].

16 INTER-AGENCY SPACE DEBRIS COORDINATION COMMITTEE (IADC), SPACE DEBRIS MITIGATION GUIDELINES, 2002 (REVISED 2007), IADC-02-01.

17 UNCOPUOS, THE SPACE DEBRIS MITIGATION GUIDELINES OF THE UNITED NATIONS COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, RES 62/217 OF 22 DECEMBER 2007, *available at* <http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines_COPUOS.pdf> [latest accessed 3 September 2013].

18 Discussion raised by *Christian Brünner* and *Irmgard Marboe* at the Symposium “Small is beautiful? Potentials and Risks of Small Satellite Projects”, Juridicum, 27 November 2012, Vienna.

to become enforceable in Austria.¹⁹ National space acts might in future check whether a simple reference is sufficiently clear to become enforceable under their domestic constitutional laws.

2.2 Constraints

For one, acceptance of the IADC guidelines requires small satellites either to be launched into very low Earth orbits where the natural decay time is less than 25 years, or requires the use of active de-orbiting means. Any active de-orbiting mechanism for example, additional propulsion, increases the mass and weight of a spacecraft. Hence it also increases the overall launch costs. As a consequence small satellite missions are likely to face the following obstacles:

1. Due to mass and budget constraints many small satellites are not able to carry additional means or propulsion for de-orbiting manoeuvres.²⁰
2. Reliable and affordable de-orbiting systems available at commercial off-the-shelf suppliers are being developed but are not fully operational yet.
3. Small satellites which are launched as a secondary payload, and therefore depend on a destination of the primary payload which is often higher than the natural decay time, are also constraint by the 25-years in orbit life-time limit if they do not have means to de-orbit.²¹

Due to the reasons mentioned above often a small satellite would miss the 25 in orbit life-time limit due to the mass mass-related, financial, technical and launching constraints.²² This general concern is also shared by the international community: tellingly, the 2013 UNCOPUOS general report states that “*some delegations expressed the view that the issue of space debris should be addressed in a manner that would not jeopardize the development of the space capabilities of developing countries.*”²³

19 Discussion with *Christian Brünner*, 10 September 2013, University of Graz with reference to Art. 18 of the Austrian constitution, Federal Law Gazette I Nr. 1/1930 latest amended Nr. 164/2013.

20 See the UNCOPUOS REPORT ON THE 3RD UN/AUSTRIA/ESA SYMPOSIUM ON SMALL SATELLITES PROGRAMMES FOR SUSTAINABLE DEVELOPMENT: “IMPLEMENTING SMALL SATELLITE PROGRAMMES TECHNICAL, MANAGERIAL, REGULATORY AND LEGAL ISSUES” (GRAZ, 2011).

21 *Ibid.* PARA 49.

22 See also the REPORT ON THE UNITED NATIONS/JAPAN NANOSATELLITE SYMPOSIUM: “PARADIGM SHIFT – CHANGING ARCHITECTURE, TECHNOLOGIES AND PLAYERS”, NAGOYA, JAPAN, 1013 OCTOBER 2012, PARA 62.

23 UNITED NATIONS REPORT OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, FIFTY-SIXTH SESSION, 12-21 JUN 2013, GENERAL ASSEMBLY OFFICIAL RECORDS SIXTY-EIGHTH SESSION SUPPLEMENT NO. 20, PARA 100, *available at* <www.osa.unvienna.org/pdf/gadocs/A_68_20E.pdf> [latest accessed 3 September 2013].

3 International Liability in Case of Damage

3.1 The Austrian Outer Space Act – The Influence on Small Satellite Missions

According to Art. II Liability Convention (LIAB)²⁴ a launching state is absolutely liable in case of damage on the surface of the Earth or to aircraft in flight. A launching state is a state that launches or procures the launching of a space object, or a state from whose territory or facility a space object is launched (Art. I LIAB). Many states try to pass the financial consequences of international liability onto the actual space operator by enacting national space legislation. Typically national space acts contain recourse clauses. The Austrian Outer Space Act stipulates in § 11 that the “government has a right of recourse against the operator”. As regards § 4 (4), the space operator has to buy an insurance cover at a minimum amount of € 60,000,000. Hence, any space operator in Austria regardless of the mass and size of space object has to buy an insurance cover at this minimum amount.

3.1.1 Promotion of Research, Science and Education

In Austria, if the space activity is in the public interest, an exception or relaxation of the insurance obligation may be given. The public interest is autonomously defined in § 4 (4) of the act as serving science, research, or educational purposes. In addition to the public interest requirement, the risks and the financial capacity of the space operator must be taken into account.²⁵ These pre-conditions have to be weighed against each other.²⁶ The implicit exoneration from a mandatory insurance obligation for research, science, and educational purposes is also unique among national space legislation.

3.1.2 Constraints

Paragraph 4 (4) Austrian Outer Space Act defines restrictively the public interest as promotion of research, science and education. This might limit cultural and artistic purposes. It is not clear whether the enumeration intentionally limits the public interest to three specific features or if cultural and artistic purposes are intentionally covered too by a wide understanding of the terms science, research and education. It is not clear under the Austrian Outer Space Act whether small satellite missions for mere cultural and artistic purposes (no scientific, research and educational purpose at all) are excluded from an insurance relaxation or not.²⁷ A non-coverage of artistic and cultural purposes as public interest might infringe Austrian constitutional law where art and the

24 CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS (1971) 961 UNTS 187.

25 SEE THE RESULT ON THE DECISION OF THE FEDERAL COUNCIL OF 15 DECEMBER 2011, FN 15 ABOVE, P. 8.

26 I. MARBOE, THE NEW AUSTRIAN OUTER SPACE, FN 14 ABOVE, 35.

27 See also A. RINNER, A NEW APPROACH TOWARDS OUTER SPACE ‘DEMOCRATISATION’? LEGAL, POLITICAL AND ECONOMIC ISSUES CONCERNING SMALL SATELLITE MISSIONS, DIPLOMA THESIS, UNIVERSITY OF GRAZ, 2013, 38.

right to carry out artistic actions are laid down as fundamental principles (Art. 17a of the Austrian fundamental act of rights²⁸).²⁹

4 Legal and Non-Legal Recommendations

4.1 Legal Recommendations

4.1.1 Small Satellites – Meeting Smart Laws?

In general, among the benefits of small satellite technologies are affordable costs and shorter production time, this can be equated to fewer or reduced financial risks. Small satellites positively contribute to technological capacity building and to strengthening socio-economic development through their wide range of applications. Small satellites often face the same cumbersome authorisation procedures as apply to larger satellites such as high space debris standards or high insurance obligations – requirements they may not be able to afford due to budgetary constraints or lack of technological complexity.

There is no doubt that binding laws in particular for space debris mitigation are urgently needed. The international community also highly welcomes implementation of space debris mitigation guidelines into national space legislation.³⁰ Only few countries have so far enacted national space acts. Therefore, small satellite missions might face unfair competition as certain countries have adopted tight authorisation requirements whereas others do not have a national space act to abide by.

4.1.2 Amendments of the Existing Guidelines

The existing space debris mitigation guidelines need to be amended. Currently the IADC guidelines strongly focus on quantitative aspects such as limiting the in-orbit life-time of spacecraft regardless of the mass and type of the application of the space activity. Coordinated de-orbiting measures of spacecraft may protect the outer space environment. It must be remembered that the de-orbiting process will take a number of years and that does not immediately mitigate remove the risk of collision.

Still, qualitative aspects such as space traffic management are not sufficiently covered by the existing guidelines. Therefore, amended space debris mitigation guidelines should focus more strongly on a broader approach towards space traffic management rather than on mere quantitative aspects such as limiting the in-orbit lifetime.

28 FEDERAL LAW GAZETTE N° 142/1867 LATEST AMENDED IN N° 262/1982.

29 Discussion with *Christian Brünner*, 10 September 2013, University of Graz with reference to Art. 17a of the Austrian fundamental act of rights.

30 UNITED NATIONS REPORT OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE, FIFTY-SIXTH SESSION, 2-21 JUNE 2013, GENERAL ASSEMBLY OFFICIAL RECORDS SIXTY-EIGHTH SESSION SUPPLEMENT NO. 20, P. 14, *available at* <www.oosa.unvienna.org/pdf/gadocs/A_68_20E.pdf> 14>.

4.1.3 Enactment and Harmonisation of National Space Legislation

Derivations in national space legislation may lead to unfair competition.³¹ For instance, a small satellite mission carried out in country with no space legislation does not face any constraints by national space law at all, whereas a small satellite project carried out in Austria for instance is bound by several conditions for authorisation. Such a varying legal landscape may also lead to licence shopping or ‘flag of convenience’ situations whereby a space activity will be carried out under the most favourable law.³² Although Art. VI OST states that national space activities need to be authorised and continuously supervised, the volume of national space legislation is growing rather slowly. A special working group called National Legislation Relevant to the Peaceful Exploration and Use of Outer Space, within the UNCOPUOS, has been established to try to overcoming the current derivation in national space legislation.³³

4.2 Non-Legal Recommendations

4.2.1 Public Awareness and Outreach

Legal actions are not the only tool to mitigate space debris. Beside the urgent need for technological capabilities to successfully de-orbit and actively remove space debris, it is paramount to generate appropriate public awareness. Each entity, whether governmental or non-governmental, and each individual alike, need to develop a common commitment toward the concept: ‘space debris free’. Therefore this paper recommends:

- 1 Space agencies and states should work together to develop a certification for good behaviour which will be granted to those entities and individuals who are in line with the space debris mitigation guidelines.
- 2 University students may create their own videos demonstrating how cool it is to be space debris free and share their experience and potential challenges when facing the current space debris mitigation guidelines. Through this exchange of information it might be easier to overcome obstacles such as longer planning phases and increase of cost when accepting the space debris mitigation guidelines.

31 See J. WHEELER, *SPACE DEBRIS: LEGAL FRAMEWORK*, FN 5 ABOVE, 256.

32 See also F. *Von der Dunk*, *TOWARDS “FLAGS OF CONVENIENCE” IN SPACE?*, PRESENTATION AT THE IISL/ECSL SYMPOSIUM ON “TRANSFER OF OWNERSHIP OF SPACE OBJECTS: ISSUES OF RESPONSIBILITY, LIABILITY AND REGISTRATION”, FIFTY-FIRST SESSION 19 MARCH 2012 UNCOPUOS LEGAL SUBCOMMITTEE (2012).

33 See the Working paper submitted by the Chair of the Working Group on National Legislation Relevant to the Peaceful Exploration and Use of Outer Space REVISED TEXT OF THE DRAFT RECOMMENDATIONS ON NATIONAL LEGISLATION RELEVANT TO THE PEACEFUL EXPLORATION AND USE OF OUTER SPACE, A/AC.105/C.2/L.289: SET OF RECOMMENDATIONS ON NATIONAL LEGISLATION RELEVANT TO THE PEACEFUL EXPLORATION AND USE OF OUTER SPACE, FOR SUBMISSION AS A SEPARATE DRAFT RESOLUTION FOR CONSIDERATION BY THE GENERAL ASSEMBLY AT ITS SIXTY-EIGHTH SESSION, *available at* <www.oosa.unvienna.org/oosa/COPUOS/Legal/2013/index.html> [latest accessed 3 September].

- 3 The distribution of a personal commitment of a space debris free philosophy might inspire other entities and individuals to also act in line with the guidelines.

With increasing public awareness it is reasonable to expect an increasing demand for alternative and affordable launching opportunities for small satellites into very low Earth orbits. This increasing public awareness may also lead to more ambitious research and development of de-orbiting methods at lower cost, affordable for small satellites. Although small satellites are criticised for their contribution to space debris, it is the small satellite community that currently drives much of the design, implementation, testing and verification of de-orbiting methods currently been investigated.³⁴ Once successful and reliable de-orbiting methods are developed, it's clear that these technologies will be adopted by the conventional satellite industry.³⁵ The small satellite community should enjoy strong support from the international community to look for reliable solutions to de-orbit. Such solutions should be ready to be produced off-the-shelf to make them affordable for non-governmental small satellite projects as well.³⁶

5 Conclusions

The Austrian Outer Space Act is a rather young and very modern law which seeks to achieve sustainability in space. It has clear rules to mitigate space debris. It stresses that pertinent internationally recognised guidelines must be taken into account. This position is a very straightforward position and highly welcomed by the international community. However, space environmental driven national space acts may pose problems for small satellite projects since many of them operate under strict budgetary constraints and cannot afford additional propulsion or alternative technology for de-orbiting. Currently off-the-shelf de-orbiting technology is not fully operational. At this time tight regulations may actually serve as an obstacle toward further democratisation of space through small satellites.

Against this background, it is important to highlight the role of non-legal strategies such as strengthening public awareness among the small satellite community, with particular focus on non-governmental entities, universities and individuals. After all, heightened public awareness may actually achieve something which legal tools might not be able to deliver yet: non-binding rules are

34 See W. BALOGH, THE ROLE OF BINDING AND NON-BINDING NORMS IN THE IMPLEMENTATION OF SMALL SATELLITE PROGRAMMES IN: I. MARBOE (ED.), *SOFT LAW IN OUTER SPACE, THE FUNCTION OF NON-BINDING NORMS IN INTERNATIONAL SPACE LAW*, 2012, 339.

35 Ibid.

36 See also Propulsion chips for miniature satellites, *RESEARCH EU RESULTS MAGAZINE*, N° 20, MARCH 2013, 44.

gradually transformed into binding rules through explicit commitments by the entities and individuals taking part in outer space activities. Building a high level of public awareness to the problem of space debris may also drive forward the research and development of affordable de-orbiting means. This will allow nations to honest the potential of small satellites to develop the required the new de-orbiting technologies, as well as to help to influence their larger national space activities.

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PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 2013

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